Hydropower safety
What is good practice?

Dr Wu Shiyong
Yalong River Hydropower Development Company, Ltd.

For more information: www.hydropower.org/congress
Safe Operation of Yalong River Cascade

Hydropower Plants

Dr. Wu Shiyong, Vice General Manager

Yalong River Hydropower Development Company, ltd.

May 20, 2015
Outline

- Brief of Yalong River
- Safety Management Policies & Procedures
- Safe Operation of Cascade Plants (dams, units, power dispatching, Environment)
- Further Work
22 stations, Owner: Yalong Hydro, this presentation on the lower reach.

**UPPER**: 2.65GW

**MIDDLE**: 11.62GW

**LOWER**: 14.7GW

🔗**Brief of Yalong River**
Jinping- I
Capacity: 3.6GW
arch dam height: 305m

Jinping- II
Capacity: 4.8GW
Power tunnel: $4 \times 16.7$km, deep-buried (2500m)

Guandi
Capacity: 2.4GW
RCC dam: 168m

Ertan
Capacity: 3.3GW
arch dam: 240m

Tongzilin
capacity: 0.6GW
gracity dam: 70m
Safety management policies & procedures

- To fully implement the responsibility system for production safety
- Improve the safety management policies
- Improve the safety risk management procedures
- Perfect emergency management system
- Strengthen safety inspection in the station
- Optimization of hydropower station operation and maintenance mode
- To increase times of technical and safety training for employee
- Safety production messages will be reinforced to create cultural atmosphere for safe, health, environmental protection
Safe operation of dams

- The number of monitoring instruments: more than 30000
- Monitoring indicators: stress and strain, deformation, seepage, and seepage-pressure etc.
- Access to the hydrological, meteorological and seismic information, etc.
- About 24 million monitoring data
- Daily engineering safety evaluation, every project is safe.
Earthquake monitoring technical system

- A seismic network system for cascade reservoirs comprises 38 digital and telemeter seismic stations, 5 relay stations, 1 network center and multi data transmission channels.

- Class-I: reservoir head region (viz. 5 - 10 km downstream and 20 km upstream from the dam sites). Class-II: the remaining areas within 10 km either side of the River.

- Strong motion observation equipment is positioned on the dams, real-time earthquake acceleration of dam can provide a rapid assessment of the impact on the dam.
Designing with high standard
Remote centralized control, unattended operation

Enhancing equipment reliability
Optimizing working condition of equipment & operation analysis, technical supervision, experience-condition based maintenance

Promoting enterprise standards
Production management system (Maximo), standardizing operating journals, work sheets, operation orders, regular work, defect treatment, materials purchasing, operation forms and security management.

Research and innovation

- Success rate of automatic ON/OFF of 24 units exceeds 97% in year of 2014
- Intact rate of main equipment at Ertan hydropower station keeps 100% over last 10 years
The remote control risks for cascade stations were researched and analyzed, and corresponding security strategy formulated.

The completed remote control security system had been built, including management interface, operating mode, policies, personnel training, emergency support and system security, etc.

The system can avoid the problems of units full stop, whole-station load loss or voltage loss, line tripping, mistakenly operated the gate and other extreme conditions as a result of channel blocking, the system crashing and other faults.
Decentralized design
Hierarchical control
Multi Data channel
Centralized control center

Power dispatching control safety

Blocking order
Safety protection
Data exchange
In 2006, the project won the national "environmental friendly project" award.

Centralized fish breeding and releasing station was established. More than 1.66 million aquatic fingerlings of rare fish species were released ever since.
Built slope stability analysis and alarming system

- Now the high slope safety monitoring analysis based on statistical trend prediction and engineering experience.
- To carry out further work to provide important technical support for slope safety evaluation in a long time.
- Exploration of new monitoring technology (GPS, Optical fiber, INsar, UAV).
- To improve a variety of alarming methods of engineering analogy and degree of safety in the deformation of slope.

Further Work

- the high slope in Jinping-I station
- monitoring high slope by Unmanned Air Vehicle
**Condition-based maintenance**

- Establishing enterprise production data center and condition-based maintenance decision system.
- Analyzing state parameter of equipment under various operation modes, to identify stability and abnormal performance.
- Predicting fault development and potential risk, the position and reason of fault can be further confirmed.

**System structure and data flow**

- Condition monitoring and trend analysis module
- Web server
- ADO.NET
- Vibration monitoring 1
- Vibration monitoring 2
- Power plant monitoring system
- Other system
- Tape library backup
- Database
- ODBC
- VIRITA

Condition monitoring and trend analysis system

Further Work

- Condition-based maintenance
Emergency command system

- **The hardware platform** mainly consists of large screen display system, image monitoring system, emergency command and dispatch system, video consultation system, wired voice communication system, wireless voice communication system, computer network system, satellite communication access system, disaster recovery and backup system, etc.

- **The software platform** will effectively integrate digital Yalong River system, dam safety MIS, flood forecasting system, reservoir dispatching automation system, etc. Through access to alarming information and combining with the digital emergency plan, decision making-aid for emergency command will be provided.
Monitoring plan of the environmental factors should be on the whole scale of the basin. Environmental information management and decision support system in the digital platform of the Yalong river, will be carried out to display and query monitoring data. The information will provide support for management's decision of environmental protection departments.

In the case of functions of electricity generation, flood control, shipping, fishing, tourism and others, the project should take into account ecological impacts of beaches, animals, plants, water temperature and so on, maintain ecological health and carry out ecological operation.
Thank you!
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Thank you!